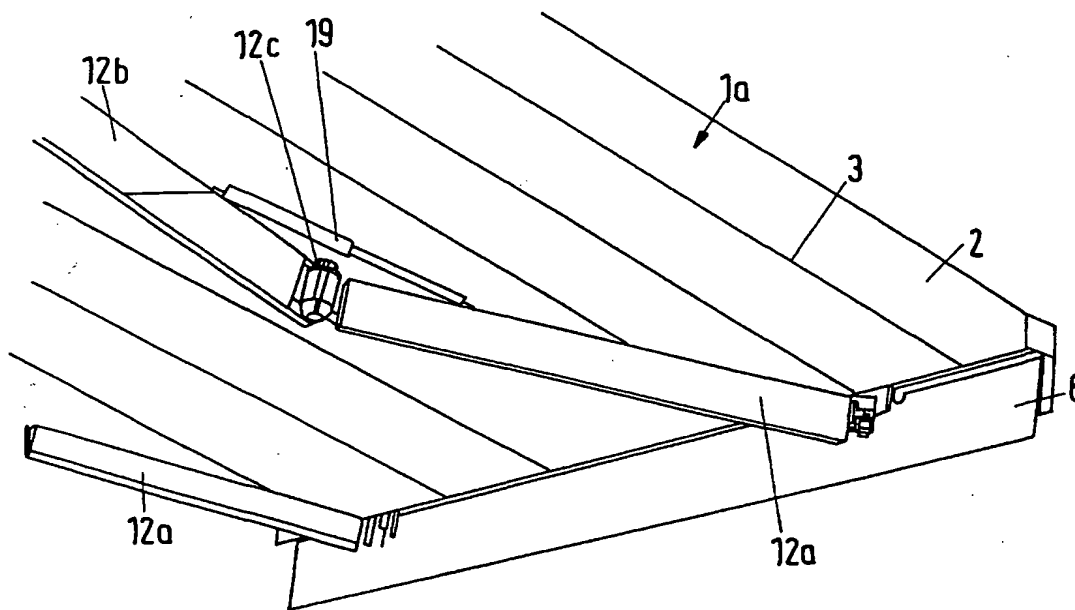


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**(54) Title:** AWNING WITH FLEXIBLE SOLAR MODULES



**(57) Abstract**

An awning has a frame (12a, 12b, 12c) and a flexible canopy (1) mounted to the frame so as to be retractable into a retracted position and extendable into an extended position. The canopy has flexible solar modules (2). The frame has a roller onto which the canopy is rolled in the retracted position. At least one storage cell is connected to the solar modules and mounted in the roller. It stores electrical energy produced by the solar modules (2). The awning can be operated by the energy stored in the storage cell.

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## AWNING WITH FLEXIBLE SOLAR MODULES

### Description

Sun visors, blinds, or awnings as protective means against sun radiation are useful in many applications and are known in the prior art for buildings and vehicles, for example, motor homes.

U.S. patent 5, 076,634 discloses a sun visor for vehicles. It has solar modules mounted on an outwardly facing surface for converting sun radiation into electrical energy to be stored in appropriate storage cells.

From German Patent 38 32 688 a rigid awning is known which is comprised of a frame (1) that has a light-transmissive foil (3) attached thereto. At the upper side a cutout is provided that receives solar modules (7) mounted on a support (8). The electricity produced by the solar modules (7) is stored in storage means (4) mounted on a base plate (2) and is used for illumination purposes. The rigid mounting of the awning presents a drawback since the awning cannot be retracted depending on weather conditions.

German patent application DE 196 20 619 describes a rollable blind for roof windows designed to reduce the amount of heat generated in an apartment by sun radiation entering through the slanted windows. The blind can be automatically rolled up (retracted) or rolled down (extended) by a motor. The energy for

operating the motor may be derived from solar modules mounted separately from the blind.

5 U.S. patent 5, 433,259 shows a retractable awning comprising an articulated slat system at the end where the awning is connected to a building, a camping trailer or motor home. The slat system provides a protective cover for the awning and carries a solar panel on one of the slats. The solar panel is of a relative small size compared to the surface area of the awning in the extended position. The amount of energy conversion achievable with such an arrangement is therefore relatively small.

10 The known sun visors or awnings that have solar modules mounted thereon all show solar modules of a small size that therefore provide only a limited amount of renewable energy. The shown arrangements of the solar modules also require a solid support structure and therefore are limited with regard to their design.

15 It would therefore be desirable to have a retractable awning that provides solar modules across a large surface area and also allows many design variations.

20 The invention is based on employing flexible (rollable) solar modules that, because of their flexibility, can be mounted, if desired, on the entire surface area of the flexible support material (fabric, foil,

film, sheet, etc.) of the canopy. It is thus possible to provide rollable (retractable) awnings for vehicles and for buildings having a large surface area covered with flexible solar modules that can produce a large quantity of renewable electric energy in order to be able to operate the awning automatically (position adjustment, rolling up and down etc.) and also to provide renewable electric energy for other electric consumers related to the awning such as lighting or cleaning devices. Also, external electrical devices can be operated by the solar-derived energy, e.g. lawn mowers, gardening tools etc.

The solar modules are thin lamellas that are securely attached to a flexible support material. Together, the support material and the solar modules attached thereto form the awning canopy. The support material can be a light-transmissive fabric that allows sufficient light to pass in order to have the space under the awning sufficiently lighted or to allow light into a room when the awning is used as a vertical shade in front of a window or door. In this context, solar modules that are transparent would be especially useful.

Rollable (retractable) awnings comprising flexible solar modules can be positioned at many angles and orientation relative to the sun. The solar modules can be distributed over a large surface area of the canopy and, therefore, can generate a

considerable amount of electric energy. By providing storage means (storage cells) for the electric energy produced, the awning and related (or unrelated electric consumers) can be operated autarkically with renewable and environmentally friendly solar energy.

It is also possible to provide openings for light to pass into the space beneath the awning. The light passing through the openings is reflected at mirrors positioned underneath the opening such that the light is uniformly distributed. The mirror can then provide the feeling of a light-transmissive awning.

It is also possible to connect solar modules to the underside of the awning canopy so that the daylight and reflected light in the space under the awning is also converted into electrical energy by the solar modules arranged underneath. Of course, the efficiency is much reduced, but additional energy can be provided in this manner to a certain extent.

The canopy, respectively, its support material can comprise light collectors (based, for example, on fluorescent compounds) that will provide additional energy to the solar modules.

However, it is also possible to envision a transparent flexible solar module for awnings which are mounted on the support material and allow light to pass through like conventional awnings.

5 It is a preferred embodiment of the invention to position the required storage cells (batteries, accumulators, capacitors) as well as the drive motor(s), the control unit, and, optionally, water reservoir(s) and air container(s), for example, to be used for cleaning the canopy of the awning, into the cylindrical body of the roller onto which the awning material is to be rolled. One or more current-conducting tracks or other electrical connections are to be mounted on the canopy of the awning in order to connect the solar modules to the storage cell(s). An electrical connector (socket) connected to the storage cell(s) may provide different consumers, for example, a lawn mower, illumination for a bill board or name plate, lights, etc. with energy from the storage cells.

10 It is also possible to connect a plurality of awnings, positioned at different locations, to one common storage cell so that the electrical current consumers can be uniformly provided with current. This is beneficial in order to compensate different efficiency of the solar modules resulting from cloudy skies that will produce different radiation intensities of the sun on the solar modules.

15 Furthermore, air filter/fan units may be provided to filter the air inside or outside the building or the vehicle. Combustion processes, mostly caused by mankind, have resulted in gases and dust particles within the air, and these pollutants present a danger

to people in the open air as well as in buildings. It would be advantageous to have a fan for filtering the air through a filtering device (active carbon particle filter or a particle filter of the type CO<sub>2</sub> Bentax gas cleaner) integrated into the awning and operated by the electrical energy stored in the storage cell.

The solar modules on the canopy over the course of time can be contaminated by dirt and dust particles which will reduce the efficiency of the solar modules. Accordingly, it may be expedient to provide a cleaning device for the solar modules. Such a cleaning device is preferably provided in the form of a cleaning strip, including nozzles and/or brushes, mounted transverse to the retraction and extension direction above or in front of the roller where the canopy will pass it. The surface of the canopy and the surface of the solar modules can then be cleaned by water and/or air, i.e., by spraying water and/or air onto the surface of the canopy. Preferably, the water spray operates in conjunction with a brush arrangement, preferably arranged at the roller, so that the canopy is scrubbed when retracted or extended.

It is also possible to collect rain water impinging on the awning in a rain gutter mounted at the awning and to clean the rain water with a coarse and fine filter before introducing it into the cleaning liquid reservoir of the cleaning device. This cleaned rain



water can then be used for cleaning the canopy. Of course, it is also possible to use tap water for this purpose when the awning is connected to a building.

5           The surface of the canopy/solar modules can be coated by a protective coating (a foil, gel or film etc.) for various purposes. Such protective coatings are known to a person skilled in the art. For example, a soil-resistant protective coating can be provided so that the canopy has a reduced tendency for soiling. Wear-resistant and/or water-repellant coatings are also possible. The protective gel  
10 or foil o coating can also be designed to prevent or delay ice formation on the awning.

It is also possible to provide a thawing device for removal of snow and ice from the awning. Such a device is, for example, disclosed in German Patent application 36 17 439.

15           The inventive awning may be used at a motor home, camping trailer, boat, yacht, or (ocean-going) ship as a sun protection and an electrical supply system. Auxiliary electrical devices can be operated with the electric energy derived by the solar modules on the awning. Camping trailers and motor homes  
20 are often equipped with a mount at the roof structure for attaching an external tent structure thereto as an extension of the living quarters. Instead of the conventional tent structure it is then possible

to use the awning as sun protection and electrical energy supply.

5 The awning can also be combined with other awnings of the same type and mounted on a central support structure such that pairs of awnings can be extended in opposite directions from the central support structure thus forming a free-standing large shade.

The awning can be operated by remote control that, for example, employs sending/receiving units operated by infrared radiation, radio waves, ultrasound, audible sound or inductive coils.

10 Advantageous details of the awning, including the arrangement of the storage cells (batteries etc.), a device for cleaning the surface of the canopy, a device for employing the solar modules in conjunction with artificial lighting, and its use in conjunction with auxiliary electrically operated devices, are disclosed in the following. It is understood that the awning can be  
15 used in connection with commercial buildings, private homes, camping trailers, motor homes, trailer homes, etc. or as a separate structure when a corresponding common support structure is provided. It can also be used in a vertical position to shade a window or glass door, i.e., it can function as a blind.

20 The inventive awning will be disclosed in the following with the aid of particular embodiments in conjunction with the accompanying drawings. It is shown in:

- Fig. 1 an inventive awning in a partial view from below;
- Fig. 2 a roller arrangement with canopy in a partial view;
- 5 Fig. 3 the arrangement of a motor drive for the roller in a partial view;
- Fig. 4 a pump schematic for pumping water for the cleaning device for cleaning the surface of the canopy;
- 10 Fig. 5 a schematic representation of two adjacently arranged awnings; and
- Fig. 6 a schematic view of an arrangement having a common support structure with four awnings attached thereto, wherein the awnings can be extended to the right and/or the left of the central support and wherein the drawing shows all four awnings in their extended position.
- 15

Fig. 1 shows the inventive awning 1 in a partial view of the underside. The solar modules in the form of solar module strips 2 are flexible and mounted on a flexible support material so that the canopy, comprised of the support material and the solar modules, can be easily rolled onto a roller 4. According to Fig. 1, the solar

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module strips 2 extend in the direction of movement (retraction and extension) of the awning 1. However, an arrangement of the solar module strips 2 perpendicularly to the direction of movement is also possible. The adjacently positioned solar module strips 2 are  
5 connected to one another in a water-tight manner whereby the design of the seams 3 will be obvious to a person skilled in the art depending upon the material to be used. It is also possible to provide a detachable connection of the solar module strips 2 to the support material in case that an exchange of the solar module strips  
10 2 should be necessary when individual strips 2 are damaged. Of course, if necessary, individual solar module strips 2 can be replaced by support material, for example, when the damaged solar module strip 2 cannot be replaced in a timely manner, in order to be able to still operate the awning 1. The solar module strips 2 can  
15 cover the entire canopy surface area or can be arranged with spacing therebetween so that the solar module strips alternate with canopy support material. The individual solar module strips may be attached to a support material and the resulting individual strips (support material strip with attached solar module strip) may then be  
20 connected to one another. It is also possible to have the entire canopy surface area covered with a single piece of solar module.

The canopy with the solar module strips 2 that are connected

to one another and the canopy support material 1a are rolled up onto or rolled down from the roller 4 and are maintained in a stretched position by the jointed supports 12a, 12b. This extension or retraction can be performed manually by a non-represented crank connected to the roller 4 provide with an eye 5 whereby the hooks of the crank will engage the eye 5 (see Fig. 2) or can be achieved by an electric motor 6. The motor 6 is mounted within the roller 4 and can be operated by actuating a switch or by an electronic control unit, for example, with the aid of a timer 7 or according to certain weather-related parameters, such as sunlight intensity, humidity, temperature, wind, etc. (see Fig. 3), measured by sensors connected to the control unit.

In order to protect the solar module strips 2 against external influences, they may be provided, individually or the entire canopy surface, with a protective coating which will not inhibit the light transmission. The type of protective coating to be selected depends substantially on the required specifications and can be selected as desired. For example, a water-repellent coating can be provided or a wear-resistant coating or a soiling resistant coating etc. The wear-resistant coating, for example, will protect against wear resulting from cleaning by a brush or the friction caused upon retraction and extension of the canopy. A soiling resistant coating will reduce, due

to its antistatic properties, adhesion of dirt particles. A protective layer against ice formation on the canopy is also possible.

It is also possible to provide heating wires within the canopy in order to provide a thawing device. The required heating energy can be derived from the storage cells charged by the solar modules on the canopy. A thawing device for an awning is, for example, disclosed in German Patent 36 17 439.

In order to store the energy that is produced by the solar module strips 2, storage cells such as batteries are required which can be positioned within the roller 4. A compact and self-contained awning is thus realized. For example, polypyrrole or lithium foil-based batteries having layers of the respective material can be used as electrode material, whereby the layers are embedded in gel. The batteries positioned within the roller 4 can be combined and connect to one another by current-conducting tracks which may have a plug-in device (electrical connector or socket) so that one is able to tap the energy stored in the batteries for eternal use. For example, it is possible to use the stored energy for a possible illumination of the free end of the awning canopy 1a that may have provided thereat an advertisement or company name on a strip 8. When the awning is connected to a building or house, the stored electrical energy can be used for garden maintenance (lawn

mowers, trimmers, hedge clippers etc.) or for lighting at night for security reasons or illumination of advertisements or company name plates etc.

5 For cleaning the surface of the awning material 1a, it is possible to provide a cleaning device 20 with brush at the awning cover 10 which must be supplied with water for the cleaning step. When the awning 1 is mounted at the wall of the building, the supply of tap water is easily realized, optionally by providing a storage container 17, so that it is possible to clean the surface of the canopy 10 1a by simply retracting or extending the canopy multiple times so that the cleaning device 20 with brush will act on the entire surface area of the canopy. However, when the supply of tap water is difficult to realize, a sufficiently large storage container 17 for cleaning water must be provided. Whether sufficient space is 15 available in the interior of the roller 4 for such a container 17 depends on the size of the awning. However, sufficient space will be available in the hollow supports 12a, 12b provided for stretching the canopy 1a or it is possible to attach container 17 at the exterior side of the supports 12a, 12b so that they are not visible by persons 20 sitting under the awning. It is furthermore, possible to provide a precipitation (rain or snow water) collecting device 14 at the free end of the awning material 1a opposite the roller 4, for example, a rain

gutter-type arrangement, which may collect, in addition to the rain water or melting snow, the water dispensed by the cleaning device 20. The water collected in the collecting device 14 is pumped by a pump 15 through a coarse and a fine filter 16 and is then directly  
5 supplied to the cleaning device 20 for further use, i.e., it is used to refill the water reservoir 17. Shut-off valves 18 are provided that are automatically operated and prevent overfilling of the reservoir 17. A water overflow may be provided at the collecting device 14.

As mentioned above, the inventive awning 1 not only can be  
10 used as protection against sun radiation and against precipitation, but can also be used, because of the presence of the solar module strips 2, to provide electrical energy derived from the sunlight. The efficiency of the solar modules depends on the intensity of the sunlight. Additional solar modules may be attached to the underside  
15 of the canopy in order to produce additional energy. This means that during the day the effect of the sun radiation will provide the greatest possible energy efficiency while at night the conversion to useful energy is practically zero. However, in cases where strong illumination devices are present in the adjacent areas, for example,  
20 in sports stadiums etc, it is possible to use the light radiation from the strong illumination devices which are used for illumination of only a certain area, but will emit horizontally propagated light rays



so that the surrounding areas are also illuminated. When these light rays impinge on the solar modules of the inventive awning, they can also be converted into electrical energy. Even though the energy yield may be low, an additional energy source is thus provided for the already present solar modules. Thus, an additional source of energy conversion is realized which otherwise would not be possible at night.

For this particular use, it is best to extend the canopy from the roller 4 such that it is positioned perpendicularly downwardly relative to the roller. For this purpose, the supports 12a, 12b must be prevented from stretching the canopy substantially forwardly and horizontally which is accomplished by the hydraulic or pneumatic device 19 that bridges the joint 12c of the two arms of the supports 12a, 12b. This can be achieved, for example, by a pivotable holder for the supports 12a, 12b positioned below the roller 4 that allows a downward positioning of the supports 12a, 12b. In the simplest scenario, the canopy 1a will be detached from the supports 12a, 12b and the pneumatic or hydraulic actuation will be deactivated. The canopy will then roll automatically downwardly when extended. Of course, by providing a pivotable arrangement of the supports 12a, 12b, the canopy will be supported and stretched and thus be of a much stiffer and secure. When a pivoting mechanism is provided at the joints 12c, the canopy, when

extended and pivoted at the joints 12c, is positioned substantially at a right angle (or any other suitable angle, preferably greater than a right angle) with approximately half its surface area in a downward position. Either the entire canopy surface area or the forward half that is folded down is thus exposed to the light rays coming from the illumination devices operating at night. The light received from the illumination devices can thus be converted into energy. As a further advantage, it should be noted that the folded arrangement, i.e., forward canopy half is folded down, also provides wind protection for persons seated under the awning.

The folding mechanism, i.e., folding the awning at approximately half its length downwardly, can also be used during the day to provide extra protection from the elements, e.g., the sun, wind, rain. A pivotable holder, when adjustable over the pivot range, can also be used to vary the angle at which the awning is positioned relative to the sun.

The batteries (storage cells) are preferably mounted within the roller 4 for storing energy produced by the solar module strips mounted on the support material. This self-contained awning can be detached from the building or vehicle and stored away or mounted at a different location. This is especially advantageous in connection with vehicles and trailers.

Since the energy storage in a battery and also the use of energy stored in batteries results in heat being produced due to the chemical processes occurring, it is necessary to remove excess heat from the arrangement.

5                   This can be solved in multiple ways.

When the batteries are positioned in the roller 4 that is provided for retracting and storing as well as extending the canopy, the heat dissipation caused by natural events such as air flow (wind) is often insufficient, especially since the roller 4 is usually mounted at a protected location along the wall of a building or a vehicle so that air flow only will pass along a portion of the roller 4. This cannot be sufficiently improved by providing the roller 4 with a fan, especially since such a fan would also require energy, and because the air flow produced by the fan only has a minimal reach. A separate tube as a housing for receiving the batteries may be mounted at the free end of the canopy. This would provide sufficient natural air flow about the entire circumference of the tube and the entire length of the tube so that, by doing so, the heat dissipation would be considerably improved without increasing cost of electrical cable connections to the batteries or storage cells by a considerable amount. Furthermore, the space that is then available within the roller 4 could be used for mounting therein other devices or

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reservoirs as disclosed above.

Another possibility of heat dissipation is the use of a cooling liquid known in various forms and preferably in the form of water. Since the amount of heat energy to be dissipated is relatively small, the required components such as cooling tubes, heat exchanger, pump, are all small and can be easily installed, for example, at the wall to which the awning is connected or at one of the supports 12a, 12b of the awning. These additional components can be even smaller when instead of cooling water a special type of cooling liquid, for example, Galinstan, is used which has a substantially improved heat conductivity, compared to water.

A possibility for energy storage is also the use of highly efficient capacitors (for example, electric double layer capacitors available from Panasonic), especially when made of environmentally safe materials, that are to be used instead of batteries because in this manner no chemical reactions take place and no heat is produced. The installation of such highly efficient capacitors depends on whether their construction allows a rotary movement about their axis (when mounted in the roller) without their efficiency being negatively effected by rotation within the roller. When this is the case, it is possible to arrange them within the roller. In other cases, highly efficient capacitors are stationarily

mounted, for example, at the vehicle or building to which the awning is connected, or, for example, in one of the supports 12a, 12b.

5 The energy stored within the batteries, accumulators, or the highly efficient capacitors can be used for operating different electrical consumers depending on the specific needs of the customer. For example, the energy can be used in connection with functions relating to the awning itself, for example, the retraction or extension of the awning from the roller, which may be controlled so as to be performed by a control unit based on a timer or sensors measuring various parameters such as temperature, humidity, 10 sunlight intensity etc. It is expedient to perform certain operations as a function of time and/or environmental influences, for example, by arranging certain sensors cooperating with an electronic control unit that will provide a controlling function according to preset parameter limits. The artisan will be able to determine easily which range and 15 magnitude the respective parameter limits should have and how to connect these sensors most effectively.

20 The stored energy can also be used for operating the cleaning devices of the canopy and/or for water storage (collecting rain water and melted snow and pumping the water into the reservoir of the cleaning device).

The energy balance of the inventive awning can further be

improved by solar modules mounted on the underside of the canopy so that the additional solar modules can collect and convert reflected sunlight

5 The inventive awning can be used on houses with curved roof structures or at bus stop shelters with curved roofs, for example, also connection with greenhouses, pavilions, and similar structures. The awning can be adapted to various types of roof structures having a concave or convex curvature. The energy stored in the storage cells can be used, for example, for operating a  
10 climate control unit in the greenhouse. In these embodiments, the frame of the awning can be a component of the constructive parts of the bus stop shelter or the greenhouse.

Since the canopy can provide both a roof as well as a sun protection means, it is possible to save material and thus produce  
15 the buildings more cheaply. The awning (comprised of the canopy and the awning frame) is matched to the curvature of the roof structure. The canopy support material having solar module strips mounted thereon can also be suspended from cables with which the awning is then pulled into position. The awning can be manually  
20 manipulated or can be moved by a respective motor.

The energy storage means, motors and other electrical devices can be mounted within the hollow space of the components

of the structure to which the awning is to be connected.

According to another embodiment, it is possible to connect a plurality of awnings 1a, 1b (Fig. 5) or 1c, 1d, 1e, 1f (Fig. 6) to one another. A common support structure may be provided. It is especially advantageous when such awnings 1c, 1d, 1e, 1f can be extended from the central support structure (not shown) to both sides (in opposite directions) so that a substantially free standing large surface area awning is provided (see Fig. 6, showing awnings 1c, 1d on one side of the common support structure and awnings 1e, 1f extending on the other side from the common support structure in the opposite direction). As shown in Fig. 6, the awnings can extend at different angles, depending on the position of the sun. All of the awnings may be connected to a central control unit and may have a common central storage cell.

For large buildings (high rise buildings, office buildings, large hotel complexes etc) that have multiple awnings in various locations it may be expedient to have all awnings connected to a central control station that may monitor, in addition to controlling the operation of the awnings (extension, retraction, angle adjustment, cleaning, etc), also the proper function of the solar modules in order to indicate at the central station when a solar module is defective and needs replacement. Also, other malfunctions may also be

5 reported electronically to the central control station so that repair and maintenance personnel can be sent out immediately. Such a central monitoring station can also be operated remote by the contractor who installed the awnings and who offers a service and maintenance contract. To a person skilled in the art, various control and monitoring devices, including computers and sensors, for such a purpose are known and will therefore not be discussed in detail in this context.

10 Institutions and businesses such as banks have bullet proof glass in their windows in order to provide extra protection. The awning material can also be embodied in a bullet-proof manner and can also be designed such that temperature fluctuations can be compensated. Bullet proof embodiment of the awning material can be realized by providing various layers of Kevlar fabric.

15 Temperature fluctuation can be compensated by integrating foamed materials and/or integrated paraffins. Such an embodiment retains more heat energy so that people can sit comfortably under the awnings even at night. The preferred size of the inventive awnings is 3 to 4 meters. However, larger or smaller size awnings are also possible.

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It is also possible to provide a substantially vertically suspended protective sheet at the awning as a lateral protection.



The visual impression of people sitting under or behind the awning can be improved by providing light-reflecting mirrors at the awning. However, awning fabric (canopy materials) are known which change according to the exterior light conditions and thus provide a uniform  
5 lighting within the space that is covered by the awning.

A further improvement of the awning would be to have a transparent solar module that allows light to pass through so that the space under the awning is not too dark and still illuminated sufficiently. This is also important when the awning is used as an  
10 individual vertical window or glass door shade, for example.

The present invention is, of course, in no way restricted to the specific disclosure of the specification and drawings, but also encompasses any modifications within the scope of the appended claims.

AWNING WITH FLEXIBLE SOLAR MODULES

## CLAIMS:

1. An awning comprising:
- 5 a frame;
- a flexible canopy mounted to said frame so as to be retractable into a retracted position and extendable into an extended position;
- said canopy having an upper side and an underside;
- 10 said canopy comprising at least one flexible solar module on said upper side;
- said frame comprising a roller onto which said canopy is rolled in said retracted state;
- at least one storage cell connected to said at least one solar module and mounted in said roller;
- 15 said at least one storage cell storing electrical energy produced by said at least one solar module.
2. An awning according to claim 1, characterized by a motor mounted inside said roller and connected to said at least one storage cell, wherein said motor is supplied with electrical energy by
- 20 said at least one storage cell for rotating said roller in order to extend and retract said canopy.

3. An awning according to claim 1, characterized by an electrical connector to connect an external electrical consumer to said at least one storage cell.

5 4. An awning according to claim 1, characterized by a cleaning device for cleaning said canopy.

5. An awning according to claim 4, characterized in that said cleaning device comprises a cleaning liquid reservoir mounted inside said roller or inside frame portions of said frame.

10 6. An awning according to claim 5, characterized by a collecting device for collecting precipitation and guiding the collected precipitation into said cleaning liquid reservoir, wherein said collecting device is connected to a forward end of said canopy remote from said roller in said extended position.

15 7. An awning according to claim 6, characterized by a pump for pumping the collected precipitation to said cleaning device, wherein a shut-off valve is provided for controlling flow to said cleaning liquid reservoir.

20 8. An awning according to claim 7, characterized by a coarse and a fine filter mounted between said collecting device and said cleaning device for filtering the collected precipitation

9. An awning according to claim 5, characterized in that said cleaning device further comprises a pump for pumping the

cleaning liquid onto the surface of said canopy.

10. An awning according to claim 4, characterized by a cover covering said canopy in said retracted state, wherein said cleaning device is mounted in said cover.

5 11. An awning according to claim 4, characterized in that said cleaning device has at least one cleaning brush.

12. An awning according to claim 1, characterized by a thawing device for thawing ice or snow collecting on said canopy.

10 13. An awning according to claim 12, characterized in that said thawing device is connected to said at least one storage cell and comprises heating wires mounted within said canopy.

14. An awning according to claim 1, characterized in that said canopy comprises a support material on which said solar modules are mounted.

15 15. An awning according to claim 14, characterized in that said solar modules are solar module strips.

16. An awning according to claim 15, characterized in that said solar module strips are arranged in or transverse to the direction of extension or retraction of said canopy.

20 17. An awning according to claim 15, characterized in that said solar module strips are connected to one another in a water-tight manner.

18.     Awning according to claim 15, characterized in that said solar module strips are arranged such on said support material that between neighboring ones of said solar module strips a strip of said support material is located.

5             19.     An awning according to claim 18, characterized in that said solar module strips are connected in a water-tight manner to said support material.

              20.     An awning according to claim 14, characterized in that said support material is a light-transmissive fabric which controls  
10             intensity of the sun light.

              21.     An awning according to claim 14, characterized in that said support material is a light collecting material transmitting additional light to said solar cells.

              22.     An awning according to claim 1, characterized in that  
15             said canopy or said solar modules comprise a protective layer that does not impeded not impede energy transmission to said solar modules.

              23.     An awning according to claim 22, characterized in that said protective coating reduces frictional wear and/or is water-repellant and/or is soil-repellant.  
20

              24.     An awning according to claim 1, characterized in that said frame comprises supports for stretching said canopy.

25. An awning according to claim 24, characterized in that said supports have a pivot device that, when activated, direct said canopy downwardly when extended.

5 26. An awning according to claim 24, characterized in that each one of said supports has a joint and a locking device for bridging said joint.

27. An awning according to claim 1, characterized by a cover covering said canopy in said retracted state.

10 28. An awning according to claim 1, characterized in that said canopy has a suspended strip member connected to an end of said canopy remote from said roller in said extended position, wherein said suspended strip member is used for advertising purposes.

15 29. An awning according to claim 1, characterized in that said at least one storage cell is mounted so as to be exposed to an air current for heat dissipation.

30. An awning according to claim 1, characterized by a cooling device with circulating cooling liquid for dissipating heat of said at least one storage cell.

20 31. An awning according to claim 30, characterized in that said cooling device comprises components for recirculating the cooling liquid and wherein said components are mounted at least

partially external to said awning in a stationary location or mounted at least partially on parts of said frame.

5           32.    An awning according to claim 1, characterized in that said at least one storage cell is a highly efficient capacitor comprised of environmentally friendly materials.

          33.    An awning according to claim 32, characterized by auxiliary external storage cells mounted stationarily to a structure to which said awning is connected.

10           34.    An awning according to claim 33, characterized by a control unit, connected to said at least storage cell, for automatically extending and retracting said canopy, wherein said control unit comprises temperature sensors, humidity sensors, and sun radiation intensity sensors, wherein said awning is operated by said control unit according to parameters measured by said sensors.

15           35.    An awning according to claim 1, characterized by auxiliary solar modules mounted on parts of said frame or a cover of said awning exposed to sun light, wherein said auxiliary solar modules are connected to said at least one storage cell to provide initial electrical energy for a first extension of said awning.

20           36.    An awning according to claim 1, characterized by a manual crank device for extending and retracting said canopy when said at least one storage cell is empty.

37. An awning according to claim 1, characterized by a remote control for operating said awning.

38. An awning according to claim 1, characterized in that said frame is part of a building structure or a roof structure.

5 39. An awning according to claim 38, characterized in that said awning is curved to match a contour of said roof structure.

40. An awning according to claim 38, having a convex or concave curvature to match said roof structure.

10 41. An awning according to claim 1, characterized in that a plurality of said awnings are arranged adjacent to one another.

42. An awning according to claim 41, characterized in that said awnings have a common support structure and are extendable in opposite directions away from said common support structure.

15 43. An awning according to claim 1, characterized in that said canopy is comprised of bullet-proof material.

44. An awning according to claim 1, characterized in that said canopy is comprised of a foamed material containing paraffins (PCM) for the purpose of storing solar heat energy and releasing heat energy after sun down.

20 45. An awning according to claim 1, characterized in that said awning material has openings, beneath which openings mirrors are mounted to distribute light into a space covered by said awning.



46. An awning according to claim 1, characterized in that said frame further comprises a tubular member connected to an end of said canopy remote from said roller, wherein said at least one storage cell is mounted in said tubular member.

5 47. An awning according to claim 1, characterized in that said canopy comprises additional solar modules on said underside.

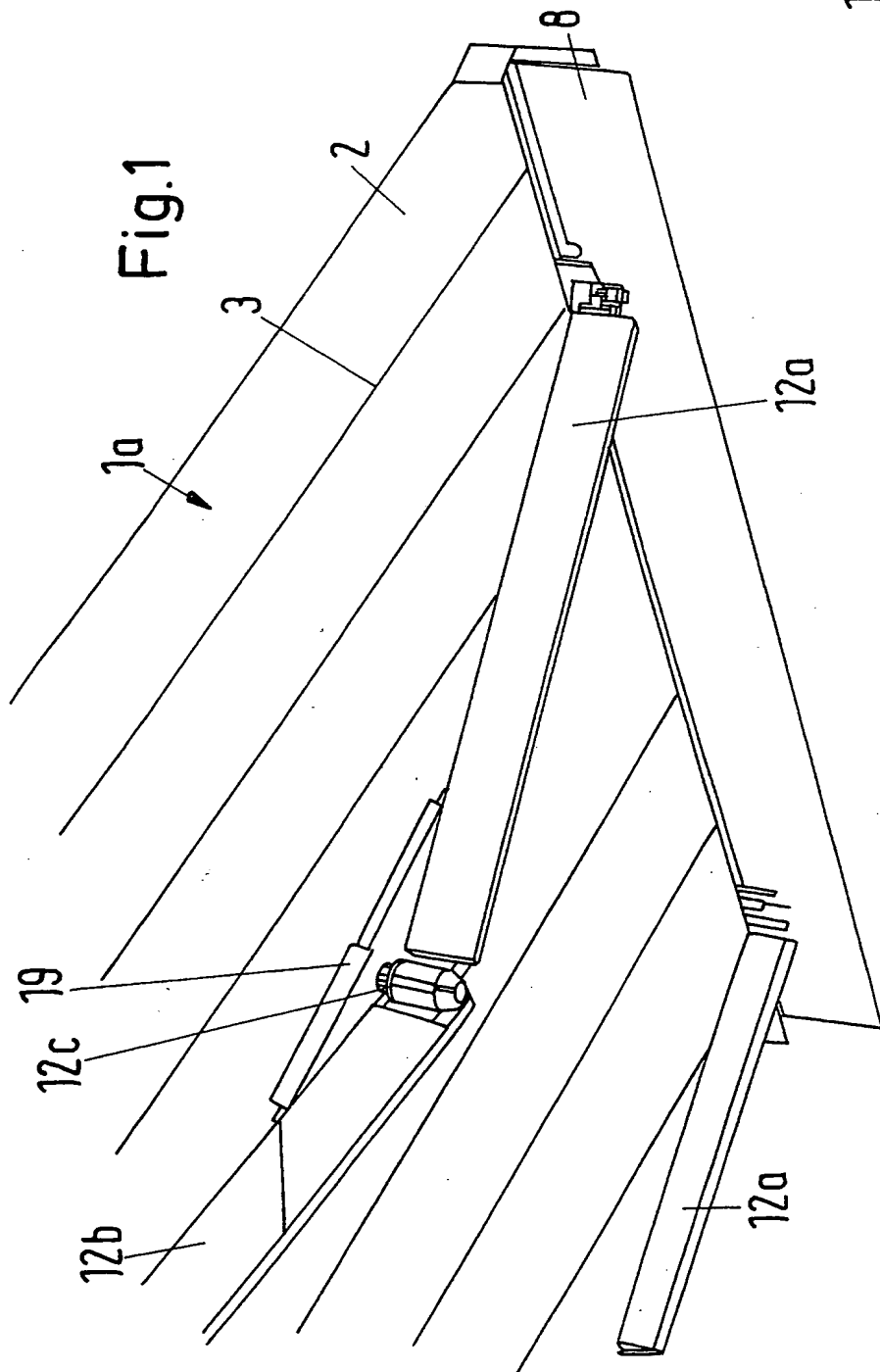
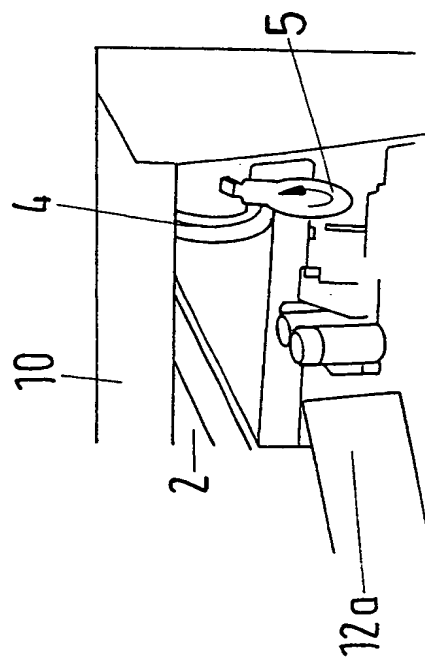


Fig.2



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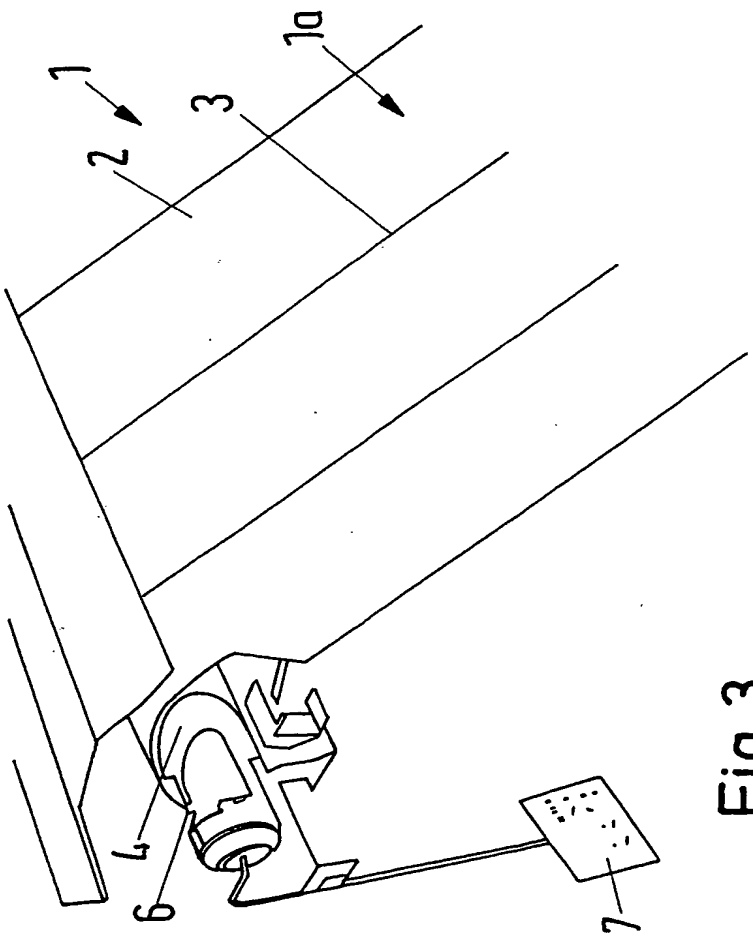


Fig. 4

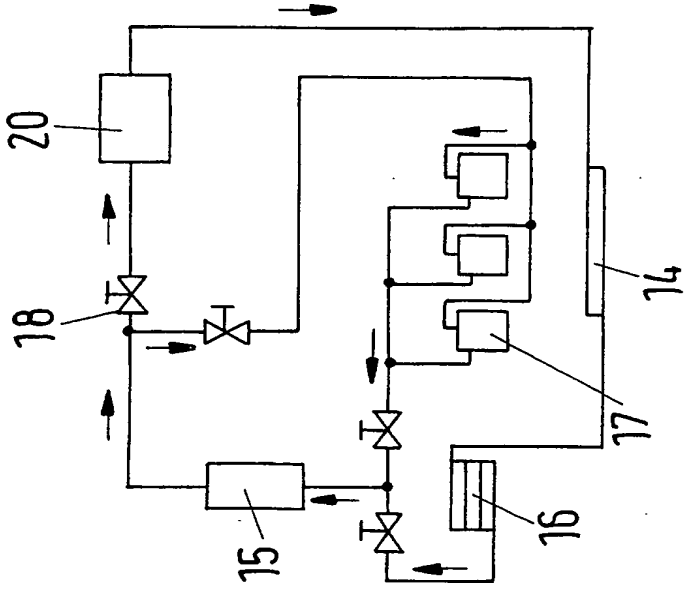


Fig.5

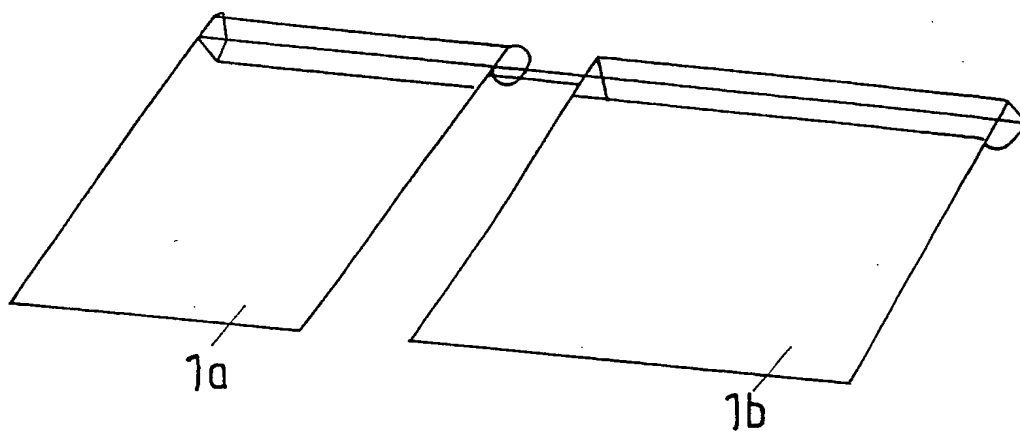
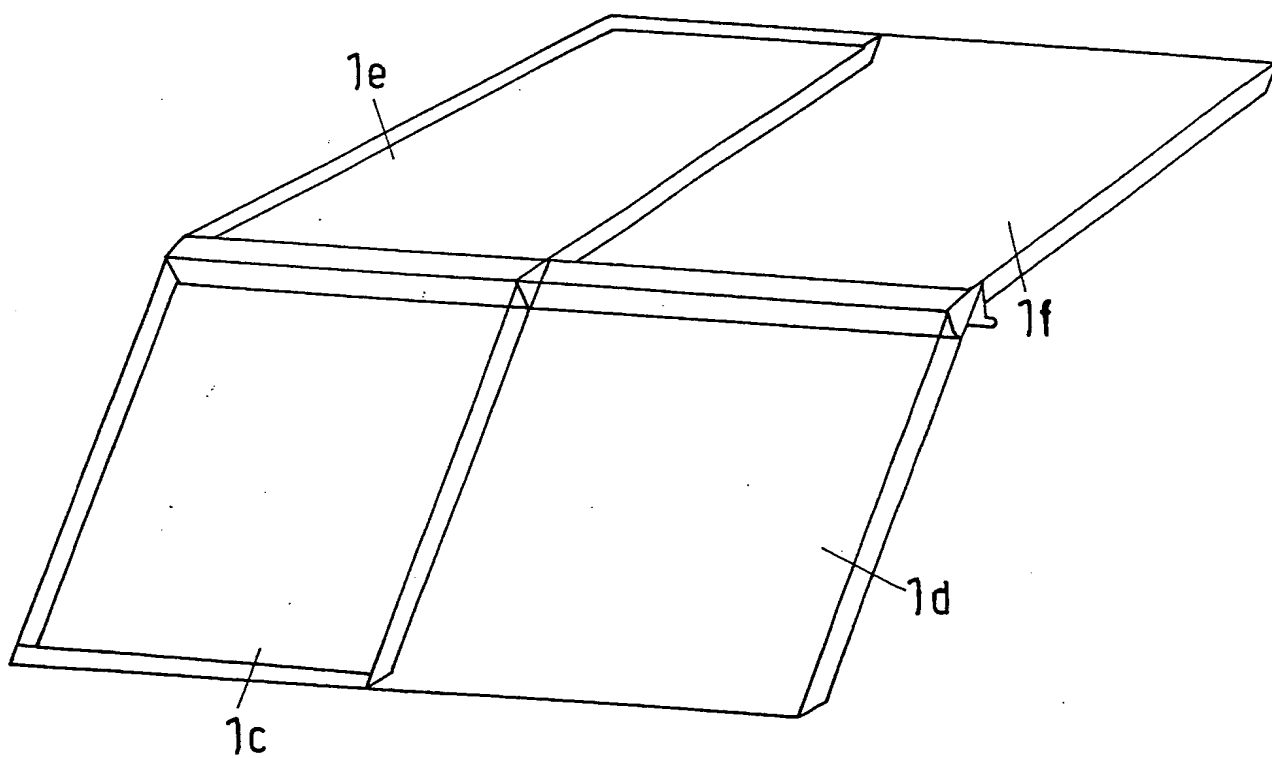


Fig.6



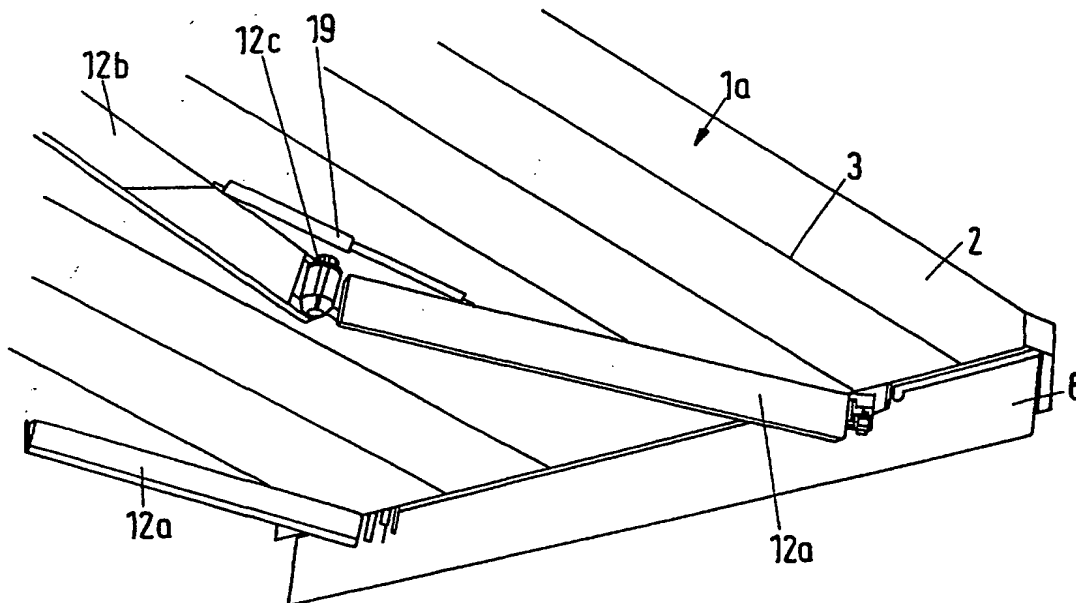
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>E04F 10/06, H01L 31/042, A47L 4/00</b>	<b>A3</b>	<b>(11) International Publication Number:</b> <b>WO 99/61721</b> <b>(43) International Publication Date:</b> 2 December 1999 (02.12.99)												
<b>(21) International Application Number:</b> PCT/EP99/03645 <b>(22) International Filing Date:</b> 26 May 1999 (26.05.99)  <b>(30) Priority Data:</b> <table border="0"> <tr> <td>198 23 902</td> <td>28 May 1998 (28.05.98)</td> <td>DE</td> </tr> <tr> <td>198 25 017</td> <td>4 June 1998 (04.06.98)</td> <td>DE</td> </tr> <tr> <td>198 44 920</td> <td>30 September 1998 (30.09.98)</td> <td>DE</td> </tr> <tr> <td>199 15 169</td> <td>1 April 1999 (01.04.99)</td> <td>DE</td> </tr> </table> <b>(71)(72) Applicant and Inventor:</b> MÜLLER, Hermann-Frank [DE/DE]; Lyngsbergstrasse 3A, D-53177 Bonn (DE).		198 23 902	28 May 1998 (28.05.98)	DE	198 25 017	4 June 1998 (04.06.98)	DE	198 44 920	30 September 1998 (30.09.98)	DE	199 15 169	1 April 1999 (01.04.99)	DE	<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>  <b>(88) Date of publication of the international search report:</b> 24 February 2000 (24.02.00)
198 23 902	28 May 1998 (28.05.98)	DE												
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198 44 920	30 September 1998 (30.09.98)	DE												
199 15 169	1 April 1999 (01.04.99)	DE												

(54) Title: AWNING WITH FLEXIBLE SOLAR MODULES



## (57) Abstract

An awning has a frame (12a, 12b, 12c) and a flexible canopy (1) mounted to the frame so as to be retractable into a retracted position and extendable into an extended position. The canopy has flexible solar modules (2). The frame has a roller onto which the canopy is rolled in the retracted position. At least one storage cell is connected to the solar modules and mounted in the roller. It stores electrical energy produced by the solar modules (2). The awning can be operated by the energy stored in the storage cell.

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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/EP 99/03645

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 E04F10/06 H01L31/042 A47L4/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 H01L H02N E04F A47L E06B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 39 09 937 A (MAN NUTZFAHRZEUGE GMBH) 4 October 1990 (1990-10-04) column 2, line 39 - line 51; figures	1-3,24, 25,27 4,10,11, 14-16, 18,20, 22,23, 25,26, 28,30, 35-37,41
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Y	--- DE 196 27 394 A (DIETZSCH WERNER DIPL ING) 13 March 1997 (1997-03-13) the whole document --- -/-	4,10,11

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

1 October 1999

Date of mailing of the international search report

17.12.99

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# INTERNATIONAL SEARCH REPORT

Intern: val Application No

PCT/EP 99/03645

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/EP 99/03645

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-11, 14-23, 26, 28, 30-31, 35, 36, 37, 41-42, 46, 47

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-11, 14-23, 26, 28, 30-31, 35, 36, 37, 41-42, 46,  
47

1.1. Claims: 1-11

Awning incorporating (known) flexible solar module(s), storage cell, roller, frame and cover, further incorporating a cleaning device with a cleaning liquid reservoir mounted inside the awning roller or inside the frame portions of its frame.

1.2. Claims: 14-23

Awning of claim 1 with solar modules mounted on support material and awning with solar modules which comprise a protective layer

1.3. Claim : 26

Awning of claim 1 with locking devices for bridging each of its supports

1.4. Claim : 28

Awning of claim 1 with suspended strip member used for advertising purposes

1.5. Claims: 35, 47

Awning of claim 1 incorporating additional/auxiliary solar modules

1.6. Claims: 30-31, 46

Awning of claim 1 incorporating various measures for the cooling and mounting of its electrical storage cell(s)

1.7. Claim : 36

Awning of claim 1 incorporating a manual crank device

1.8. Claim : 37

Awning of claim 1 incorporating remote control

1.9. Claims: 41-42

Awning of claim 1 incorporating a plurality or individual awnings arranged adjacent to one another

2. Claims: 12-13

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Awning of claim 1 incorporating a thawing device

3. Claims: 29, 32-34

Awning of claim 1 incorporating various measures for the cooling and mounting of its electrical storage cell(s)

4. Claims: 38-40

Awning of claim 1 incorporating a frame which is part of a building or roof structure

5. Claim : 43

Awning of claim 1 with canopy comprised of bullet-proof material

6. Claim : 44

Awning of claim 1 with canopy comprised of a foamed material containing paraffins

7. Claim : 45

Awning of claim 1 with openings beneath which mirrors are mounted

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern: al Application No

PCT/EP 99/03645

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